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Teleconnections between tropical Pacific sea surface temperature anomalies and North Carolina precipitation anomalies during El Niño events

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Abstract. Linear teleconnections of El Niño events and precipitation over a regional coastal land mass were analyzed. Two statistical techniques were used. First, the Empirical Orthogonal Function extracted major variances of the monthly tropical Pacific sea surface temperature anomalies and coastal North Carolina precipitation anomalies. Second, the Canonical Correlation Analysis calculated the linear combinations of the anomaly data sets that were highly correlated. The results show that El Niño-related precipitation anomalies along the North Carolina coast were positive from November to May and negative between June and October consistent with large-scale studies. Results indicate simple, linear statistical techniques can be effectively adopted to determine teleconnections on a local scale.

1. Introduction

El Niño is the term applied to the anomalous warming of the eastern and central tropical Ocean. This warming occurs irregularly every 2-7 years and lasts for several months. El Niño is one of the most important phenomena in the tropical ocean system at the interannual time scale. El Niño episodes can have variable amplitudes, but tend to have a similar phase. Early signs of the warming generally appear in March to May, building to a peak between December and February of the following year, and by May to July the sea surface temperatures (SSTs) tend to be normal again [*Rasmusson and Carpenter*, 1982]. The anomalous cooling of the tropical Pacific Ocean, on the other hand, is known as a La Niña event. Between the period 1950 to 1996, there were 15 El Niño and 10 La Niña events [*Trenberth*, 1997]. These events have a profound impact on regional as well as global precipitation patterns.

This study examines the ability of two simple, linear statistical techniques to extract the impact of El Niño on precipitation at a local to regional scale. For validation, the spatial and temporal evolutions of the monthly precipitation anomalies along the North Carolina coast and their teleconnections with El Niño are studied. This region, incidentally, is also of particular interest, because of the potential for beach erosion and property damage due to increased coastal storm frequencies. Thus, determining the possible correlation between the North Carolina coastal precipitation and El Niño events, is the other related objective of this study. Results from several large-scale studies that correlate and predict the impact of El Niño on climate variations over the United States are available [e. g., *Hoerling et al.*, 1997; *Livezey et al.*, 1997]. In the southeastern United States and northern Mexico, *Ropelewski and Halpert* [1986,1987] found that 81% of the El Niño events from 1885 to 1980 were associated with above normal precipitation starting in October of the El Niño year to March of the following year. More recently, *Montroy* [1997] showed that during El Niño, the eastern and central tropical Pacific SST anomalies have a positive correlation with precipitation in the southeastern United States between November and March, and a negative correlation occurs in July and August. The ability of linear statistical techniques to extract these features for a regional domain (coastal North Carolina) is investigated in the following sections.

Data and methodology are given in section 2. Section 3 provides results and discussion. Conclusions are presented in section 4.

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2. Data and Methodology

Predictor data used in this study were monthly SST anomalies of the tropical Pacific Ocean (122.5°E to 67.5°W and 30.5°N to 29.5°S) from January 1982 to December 1997 with a horizontal resolution of 3° x 3°. The individual monthly SST values were obtained and interpolated from the Optimum Interpolation (OI) data sets of the Climate Prediction Center / National Oceanic and Atmospheric Administration. This time-series carries signatures of six El Niño events (1982-83, 1986-88, 1991-92, 1993, 1994-95, and 1997). The data field to be predicted (predictand) was the monthly precipitation anomalies for zero-month lead over coastal North Carolina. Locations of the 28 North Carolina coastal stations used in this study are shown in Fig.1. Monthly

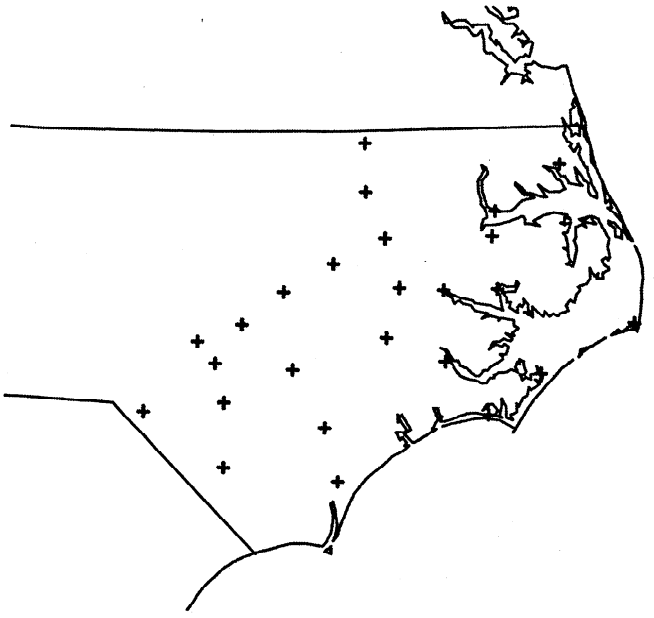

Figure 1. Locations of North Carolina coastal precipitation stations.